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Indian Standard

METHOD FOR SCLEROSCOPE HARDNESS TESTING OF METALLIC MATERIALS

(First Revision)

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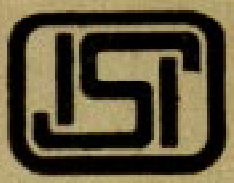

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(First Revision)

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Indian Standard

METHOD FOR SCLEROSCOPE HARDNESS TESTING OF METALLIC MATERIALS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 31 July 1981, after the draft finalized by the Methods of Physical Tests Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1973. In this revision, more detailed requirements for the testing equipment and procedure have been incorporated.

0.3 The most common application of the scleroscope test is for testing of components and parts like large die blocks, crankshafts, hardened and ground lathe bends, machine tool ways, forged steel and wrought alloy steel rolls. It may also be used for thinner materials like sheets and flats, but the method is less accurate for thinner materials.

0.4 Scleroscope is also widely used for testing various non-metallic materials like carbon, graphite, metallized graphite, rubber, etc. However, this standard is not applicable for testing of such non-metallic materials.

0.5 In the preparation of this standard, assistance has been derived from the following :

ASTM E 448-72 Standard recommended practice for scleroscope hardness testing of metallic materials. American Society for Testing and Materials.

JIS Z 2246-1976 Method of shore hardness test for metallic materials, Japanese Industrial Standards Committee.

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the method for determination of the scleroscope hardness of metallic materials.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Scleroscope Hardness Test — A dynamic indentation hardness test using a calibrated instrument that drops a diamond tipped hammer from a fixed height on to the surface of the material under test. The height of rebound of the hammer is a measure of the hardness of the material.

2.2 Scleroscope Hardness Number (HSI or HSR) — A number related to the height of rebound of a diamond-tipped hammer dropped on the material being tested. It is measured on a scale determined by dividing into 100 units, the average rebound of the hammer from a quenched (to maximum hardness) and untempered high carbon water hardening tool steel test block.

2.3 Forged Roll Scleroscope Hardness Number (HFRSI or HFRSR) — A number related to the height of rebound of a diamond-tipped hammer dropped on a forged steel roll. It is measured on a scale determined by dividing into 100 units the average rebound of a hammer from a forged steel roll of accepted maximum hardness.

2.4 Verification — The process of checking an instrument for the purpose of assessing the indicating errors.

2.5 Calibration — Determination of the values of the significant parameters by comparison with values indicated by a reference instrument or by a set of reference standards.

3. TEST EQUIPMENT

3.1 The instrument used for determining scleroscope hardness is supplied in two models designated

a) Model I — Indicating, and

b) Model R — Recording.

3.1.1 *Scleroscope Model I* — This model consists of a vertically disposed barrel containing a precision bore glass tube. A scale graduated from 0 to 140 is set behind and is visible through the glass tube. A pneumatic actuating head, affixed to the top of the barrel, is manually operated by a rubber bulb and tube. In some instruments the release of the hammer is effected by means of a trip lever.

A hammer drops from a specified height and rebounds within the glass tube.

3.1.2 *Scleroscope Model R* — This model is known as the Dial Recording Scleroscope. It consists of a vertically disposed barrel containing a clutch to arrest the hammer at maximum height of rebound. This is made possible by using a hammer which is longer and heavier than the hammer in Model I scleroscope and which develops the same striking energy in dropping through a shorter distance.

3.2 Diamond-Tipped Hammer

3.2.1 There are two sizes of diamond-tipped hammers commonly used in the scleroscope hardness instruments, as given below :

	Model I	*Model R*
Diameter	5·94 mm	7·94 mm
Mass	2·300 ± 0·500 g	36·0 ± 2·0 g
Overall length	20·7 to 21·3 mm	101·33 to 104·10 mm
Distance through which the hammer falls	251·2 + 0·1, − 0·4 mm	17·9 + 0·4, − 0·5 mm

3.2.2 The geometry of the diamond tip is of significance only at its ultimate extremity because of the limited penetration of the diamond into the material being tested. The variation in hardness of commercially available industrial diamonds has a significant effect on the readings of a rebound-type 'hardness instrument'. Consequently, the geometry of the diamond should be shaped to produce a correct reading on reference bars of known hardness. In profile, the diamond is convex, having an approximate radius terminated by a flat striking surface as shown in Fig. 1. The flat striking surface is approximately circular and from 0·1 to 0·4 mm in diameter, depending on the type of instrument and the hardness and other physical characteristics of the diamond.

3.3 Supporting Devices — The three supporting devices used most frequently with the scleroscope are:

a) the clamping stand,

b) the swing arm and post, and

c) the roll testing stand.

3.3.1 Smaller specimens may be tested in the clamping stand which has a a jaw capacity of 75 mm high by 65 mm deep.

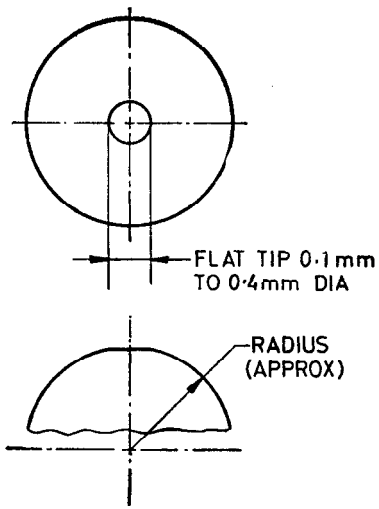

FIG. 1 PROFILE OF SCLEROSCOPE DIAMOND SHOWING RANGE OF DIAMETERS OF FLAT TIP

3.3.2 Large specimens, beyond the jaw capacity of the test stand, may be tested with the instrument mounted on the swing arm and post or the roll-testing stand. The swing arm and post has a height and reach capacity of 230 mm and 350 mm respectively.

3.3.3 The roll testing stand may be used for mounting the instrument on cylindrical specimens with a diameter of 65 mm and upward without limit.

3.4 Model I scleroscope may be used free hand for testing specimens with a minimum mass of 2·3 kg. It is not recommended that model R scleroscope be used free hand.

3.5 Test Stand Anvil — It is essential that the anvil be free of all foreign matter before mounting a specimen upon it. Foreign matter on the anvil may cause erratic readings.

4. TEST SPECIMENS

4.1 Thickness — Thin strips or sheets may be tested, with some limitations, but only when the scleroscope is mounted in the test stand. The minimum thickness of sheet in various metals that may be tested is as given below:

Material	*Thickness* (mm)
Hard Steel	0·13 to 0·15
Half-hard brass strip	0·25
Cold-rolled steel	0·25
Annealed brass sheet	0·38

4.1.1 Thin materials or those weighing less than 2·5 kg should be clamped to acquire the inertia of the support.

The sound of the impact is an indication of the effectiveness of the clamp. A dull thud indicates that the sample has been clamped solid, whereas a hollow ringing sound indicates that the sample is not tightly clamped or is warped and not properly supported.

4.2 Finish — The degree of test surface finish is important. An excessively coarse finish will yield low and erratic readings. Hence, when necessary, the surface shall be filed, machined, ground or polished to permit accurate, consistent readings to be obtained. Care should be taken to avoid overheating or excessively cold working the surface.

In proceeding from soft metals to hardened steel the required surface finish ranges from a minimum finish as produced by a No. 2 file to a finely ground or polished finish.

4.3 Magnetization — The tests should not be carried out on magnetized materials. Any magnetization of specimen or hammer shall result in low readings.

4.4 Parallelism — The opposite sides of specimens tested in the test stand should be parallel.

5. TEST PROCEDURE

5.1 To perform a test with either Model I or Model R scleroscope, hold or set the instrument in a vertical position with the bottom of the barrel in firm contact with the test specimen. Bring the hammer to the elevated position and then allow it to fall and strike the test surface and measure the height of rebound.

5.2 When using Model I scleroscope, bring the hammer to the elevated position by squeezing and releasing the rubber bulb. Release the hammer by again squeezing the rubber bulb. Some instruments are provided with a recoil-type mechanism to eject the indentor up, where it is held in position by a catch.

The height to which the hammer rebounds on the first bounce indicates the hardness of the material.

5.3 When using Model R scleroscope bring the hammer to the elevated position by turning the knurled control knob clockwise until a definite stop is reached. Release this control knob to allow the hammer to strike the specimen and observe the reading recorded on the dial. The dial hand comes to rest at a value that indicates the hardness of the material.

5.4 Alignment — To prevent errors resulting from misalignment, the instrument should be set or held in a vertical position, using the plump bob or spirit level on the instrument to determine verticality. Lateral vibrations should be avoided, since they tend to cause the free fall of the hammer to be impeded and, hence, cause the instrument to read low.

5.5 Spacing of Indentation — An error may result if the indentations are spaced too closely together. Space indentations at least 0·5 mm apart and make only once at the same spot. The hardness test shall be performed at a place not less than 6 mm from the end surface of the specimen.

5.6 The clamping force to be applied to the specimen during hardness test shall be approximately 20 kgf (1966 N) or more.

5.7 The dial hand of Model R normally comes to rest at the last hardness reading taken. Although the hand returns momentarily to zero in the course of each test cycle, it does not normally remain at zero.

5.8 In the case of the direct rebound instrument, the height of hammer is not easy to observe, special care being necessary in making tests. It is recommended that a few trials be made on the test piece, in order to determine that particular part of the scale to which the rebound shall be confined.

6. MEASUREMENT OF HARDNESS

6.1 The measured value of the hardness shall be the mean value of five consecutive measurements.

6.2 The values shall be read in 0·5 units. The mean value shall be expressed to the first decimal place.

6.3 However, the value of standardized hardness test block measured shall be read in 0·1 unit.

7. REPORT

7.1 The report shall include the following information :

a) the scleroscope hardness number,
b) the type of scleroscope instrument used, and
c) the test conditions.